## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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| Serial No.: | **10/533,567** | ) | Group Art Unit: | 1793 |
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| Applicants: | DOMEN *et al.* | ) | Examiner: | J. A. Smith |
| | | ) | | |
| Filed: | 03 May 2005 | ) | Customer No. | 62,479 |

Invention:   **Novel solid acid catalyst**


## APPEAL BRIEF

Pursuant to the Notice of Appeal filed May 4, 2009, Applicants submit this Appeal Brief.

# TABLE OF CONTENTS

# TABLE OF AUTHORITIES

**Cases**

**Statutes**

**Rules**

**Real Party in Interest**

Japan Science and Technology Agency

**Related Appeals and Interferences**

None

**Jurisdictional Statement**

The Board has jurisdiction under 35 U.S.C. 134(a). The Examiner mailed a final rejection on July 24, 2008, setting a three-month shortened statutory period for response. The time for responding to the final rejection expired on November 24, 2008. Rule 134. A Request for Continued Examination (RCE) and amendment was filed on November 20, 2008. A notice of appeal and a request for a pre-appeal brief conference was filed no May 4, 2009, after a subsequent non-final Office Action dated February 4, 2009. The decision of the panel was mailed on May 29, 2009. The time for filing an appeal brief is two months after filing the notice of appeal or one month from the mailing of the panel decision, whichever is greater. Bd.R. 41.37(c). Under the Saturday, Sunday, Holiday rule, the appeal brief is timely filed on July 6, 2009.

## Status of Claims

Claims 1, 3, 5, 10 and 12 are the subject of this appeal. Claims 2, 4, 6-9, 11 and 13-14 are canceled. No other claims are pending.

## Status of Amendments

An amendment filed May 4, 2009 was entered by the examiner.

## Grounds of Rejection to be Reviewed

1. Rejection of Claims 1 and 3 as being unpatentable under 35 U.S.C. 103(a) over Takagaki *et al.*, "Structure of Titanium Niobate Oxide Sheet and Solid Acidity," 90th Catalyst Forum of Catalyst Soc., Sept. 10, 2002.

2. Rejection of Claim 10 as being unpatentable under 35 U.S.C. 103(a) over Takagaki *et al.*, *supra*.

3. Rejection of Claim 5 as being unpatentable under 35 U.S.C. 103(a) over Takagaki *et al.*, *supra*, in view of Hara *et al.*, "Metal Oxide Nano-sheet as Solid Acids," Shokubai, June 10, 2002; 44: 4.

4. Rejection of Claim 12 as being unpatentable under 35 U.S.C. 103(a) over Takagaki *et al.*, *supra*, in view of Hara *et al.*, *supra*.

## Grouping of Claims

Claims 1, 3, 5, 10 and 12 do not stand or fall together. Each claim has been argued separately for each respective ground of rejection.

## Statement of Facts

The subject patent application relates to a solid acid catalyst represented by $HTi_xNb_yO_5$, where $1.1 < x < 1.2$ and $0.9 > y > 0.8$. The solid acid catalyst has a Ti/Nb atomic ratio $z$, where $1.2 < z < 1.4$ (specification at p. 2, ¶ 2 to p. 3, ¶1). Claim 1 is a product-by-process claim which defines the claimed solid acid catalyst by the process by which it is obtained (Claim 1). The process includes proton changing of alkali metal cation of cation changeable lamellar metal oxide in which polyanion nano-sheet comprising lamellar metal oxide layers of titanium niobate lying alkali metal cation between are regularly laminated by inorganic acid or organic acid adjusted to 0.0001M to 1M, delaminating said laminated layers temporarily by inserting cation selected from the group consisting of organic amine or organic ammonium between layers of proton exchangers, preparing an aqueous colloidal solution comprising metal oxide sheets to exchange said organic amine or organic ammonium by adding inorganic acid or organic acid adjusted to 0.0001M to 1M to

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said aqueous colloidal solution, and simultaneously coagulating on titanium

niobate nano-sheet (specification at p. 3; Claim 1).

In rejecting Claims 1, 3, and 10, the examiner cited Takagaki *et al.* (Office

Action p. 3, ¶ 1). The examiner alleged that the claimed product is similar to, if

not the same as, that described in Takagaki *et al.*, although produced by a different

process (Office Action at p. 3, ¶ 2). In rejecting Claims 1 and 3, the examiner

stated that process limitations in a composition are given little weight (Office

Action at p. 3, ¶ 2; p. 5 ¶ 1). This formed the basis of the examiner's *prima facie*

case of obviousness as to the claimed composition (*see* Office Action at p. 3, ¶ 2).

Takagaki *et al.* teaches 2-dimensional metal oxide sheets composition of

$HTiNbO_5$, $HTi_2NbO_7$, or $H_{0.9}Ti_{0.9}Nb_{1.1}O_5$ (Abstract and Section 3). In these cases,

*x* is 1, 2, and 0.9, and *y* is 1, 1, and 1.1. *Id.* The Ti/Nb atomic ratio *z* in those cases

is 1, 2, and 0.818, respectively (*see* Response of 05/04/2009 at p. 5, ¶ 4).

On the other hand, and as a factual matter, the examiner incorrectly stated

that that the value of "y" in $H_{0.9}Ti_{0.9}Nb_{1.1}O_5$ in Takagaki *et al.* is 1.9, and

incorrectly calculated the Ti/Nb atomic ratio (z) is in the range from 0.833 to 5, for

the compositions $HTiNbO_5$, $HTi_2NbO_7$ and $H_{0.9}Ti_{0.9}Nb_{1.1}O_5$ (Office Action at p. 3,

¶ 1).

Although the examiner acknowledged that the Ti/Nb proportions do not overlap, obviousness was alleged on the basis that there would be sufficient motivation for one skilled in the art to modify those proportions to reach the claimed ranges (Office Action at p. 3-4).

The present invention teaches one preferred embodiment where the organic amine or organic ammonium is either ethylamine, propylamine, or tetrabutylammonium (specification at p. 3). This is the subject matter of Claim 3. In rejecting Claim 3, the examiner cited Section 2 of Takagaki *et al.* for the limitation that the organic ammonium used in the catalyst production process is tetrabutylammonium (Office Action at p. 5, ¶ 1).

In rejecting Claims 5 and 12, the examiner cited Takagaki *et al.* and Hara *et al.* (Office Action at p. 5, ¶ 3). In rejecting Claim 5, the examiner again stated that process limitations in a composition claim are given little weight (Office Action at p. 5, ¶ 3).

The first preferred embodiment of the present invention can further include a limitation that the surface area of the coagulated titanium niobate nano-sheet is 10 times or more the surface area of the cation changeable lamellar metal oxide proton exchanger (specification at p. 3). This surface area ranges from $60m^2/g$ to $150m^2/g$ (*Id.*). This is the subject matter of Claim 5.

Takagaki *et al.* does not disclose a surface area of the titanium niobate oxide sheet (*see* Office Action at p. 5, ¶ 3). The examiner alleged that Hara *et al.* teaches preparation of the catalyst $HTiNbO_5$ in an aqueous solution of tetrabutyl-ammonium and with a 0.1M solution of nitric acid, where the metal oxide sheets have 150 times larger surface area compared with that before the removal-coagulation process (*see* Office Action at p. 5, ¶ 4; Section 2). The compounds disclosed in Hara *et al.* are different from those of Takagaki *et al.* (*see* Hara *et al.* at Section 3; *see* Takagaki *et al.*).

Comparative Example 1 of the present invention states that the surface area after removal-coagulation of $HTiNbO_5$ is 143 $m^2/g$ (specification at p. 8). Hara *et al.* teaches that the surface area is 150$m^2/g$ for this compound (Section 3, ¶ 2). The present specification teaches that as $x$ and $y$ change, the surface areas change.

A second preferred embodiment of the present invention is one where the solid acid catalyst is an ester dehydration condensation catalyst (specification at p. 3).

In rejecting Claims 10 and 12, the examiner alleged that Takagaki *et al.* teaches in Section 3 that there is high activity in the esterification reaction with the titanium niobate oxide sheet aggregate than there is with zeolite or hydrous niobic acid (Office Action at p. 5, ¶ 2). Takagaki *et al.* further discloses that when the

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composition of $HTiNbO_5$ is changed, acid catalytic activity is changed such that

higher activity in the esterification reaction is obtained with the composition

$H_{0.9}Ti_{0.9}Nb_{1.1}O_5$ (Results and Conclusion). In rejecting Claim 10, the examiner

concluded that one would be motivated to modify the claimed invention as for

Claim 1 in order to achieve improved catalytic activity (Office Action at p. 5, ¶ 2).

The examiner alleged that Claim 12 simply recites the intended use of the

claimed invention (Office Action at p. 6 ¶ 1). The examiner required that

Applicants show a structural difference between the claimed invention and the

prior art to overcome the rejection. *Id.* In contrast, the examiner did not place the

burden of showing a structural difference on Applicants regarding Claim 10 (*see*

Office Action at p. 5-6).

Hara *et al.* teaches that $HTiNbO_5$ aggregate produces good activity as a solid

acid catalyst for liquid phase esterification (Section 3, ¶ 2). Hara *et al.* also teaches

that not all two dimensional polyanion sheets act well as a solid acid catalyst, but

only a sheet having a specific structure will perform well as a solid acid catalyst.

*Id.*

Takagaki *et al.* teaches that as the Ti/Nb ratio changes, so does catalytic

activity in liquid phase esterification of the composition (Section 3). The present

specification teaches that the solid acid catalyst with $x$, $y$, and $z$ as claimed

performs better in liquid phase esterification than those outside the claimed ranges (Fig. 3). Takagaki *et al.* teaches that acid catalytic activity is changed due to the change in composition where a composition with x=0.9 and y=1.1 (Ti/Nb=0.818) has higher activity than the original composition having x=1, y=1 (*i.e.* Ti/Nb=1) (Section 3). In contrast, the present invention teaches that higher catalytic activity occurs in the claimed Ti/Nb z ratio range of 1.2<z<1.4, which is outside the preferred range disclosed by Takagaki *et al.*

# ARGUMENT

## I. Claims 1 and 3 are improperly rejected under 35 U.S.C. 103(a) as being unpatentable over Takagaki *et al.*

### A. Takagaki *et al.* Does Not Teach or Suggest All Claimed Limitations

The examiner's analysis of the Takagaki *et al.* reference is flawed; Takagaki

*et al.* does not teach or suggest every limitation of the rejected claims. *See*

Response of 11/20/2008 at p. 4, ¶ 2; *see also* Response of 05/03/2009 at p. 5-6. In

addition to citing miscalculated values which fail to establish the *prima facie* case,

the examiner has failed to provide a reasonable explanation for the conclusion that

the claimed ratios are contained in the Takagaki *et al.* compounds.

For either of Claims 1 and 3, the Ti/Nb proportions taught by Takagaki *et al.*

do not overlap the claimed ratio range. Table A below sets forth the Ti/Nb atomic

ratio z values from Takagaki *et al.* compared to the claimed values (*supra*, at ¶ 1).

TABLE A

| Variable | Takagaki *et al.* Value | Claimed Value |
|---|---|---|
| Ti $= x$ | 1, 2, 0.9 | 1.1 – 1.2 |
| Nb $= y$ | 1, 1, 1.1 | **0.8 – 0.9** |
| $\dfrac{Ti}{Nb} = \dfrac{x}{y} = z$ | 1, 2, **0.818** | 1.2 – 1.4 |

*See* Response of 05/03/2009 at p. 5, ¶ 1.

From Table A, it can be plainly seen that the claimed Nb value of $y$ being

$0.9 > y > 0.8$ is not taught by the reference (Response of 05/03/2009 at p. 5, l. 19).

Also, the correctly calculated values clearly show that Takagaki *et al.* does not

teach that $z$ is in the range from **0.833** to **5** for the compositions of $HTiNbO_5$,

$HTiNbO_7$, and $H_{0.9}Ti_{0.9}Nb_{1.1}O_5$ (Office Action at p. 3, ¶ 1). Notably, the examiner

stated that the Ti/Nb ratio in these cases is 1, 2, and 0.818, where $x$ is 1, 2, and 0.9

and $y$ is 1, 1, and 1.9. However, the correct $y$ value in $H_{0.9}Ti_{0.9}Nb_{1.1}O_5$ is not 1.9, as

asserted by the examiner, but rather 1.1 (Takagaki *et al.* at Section 3). The

correctly calculated $z$ values of Takagaki *et al.* are the distinct data points of 1, 2,

0.818 set out in Table A. No support is provided for a range of 0.833 to 5. *See*

Response of 05/03/2009 at p. 4-5, *see also* Response of 11/20/2008 at p. 6.

The examiner alleged that although Takagaki *et al.* does not teach the same

ratio ranges, there would be sufficient motivation for one skilled in the art to

modify the compositional proportions to overlap the claimed values (Office Action

at p. 4). As a basis for this conclusion, the examiner cited the Introduction of

Takagaki *et al.*, which discloses that the "investigation of changes in catalytic

activity associated with changes in atomic ratios has been conducted in the past."

*Id.*

However, this fails to "broadly disclose" the claimed invention, or indeed, an exemplified embodiment as conceded by the examiner (Office Action at p. 3, ¶ 3). Instead, the reference teaches away from the claimed invention by suggesting that a z ratio of Ti/Nb=0.818 has higher activity than the original composition having x=1, y=1 (*i.e.* Ti/Nb=1). *See* Response of 11/20/2008 at p. 5. Takagaki *et al.* only discloses single data points for the atomic ratio z and not a range of optimal values. To the extent that one of ordinary skill would experiment with additional values and ranges based on the teachings of the reference, Takagaki *et al.* would clearly motivate one of ordinary skill to experiment away from the claimed range. *See* Response of 11/20/2008 at p. 5. For example, Takagaki *et al.* teaches that the composition $H_{0.9}Ti_{0.9}Nb_{1.1}O_5$, which has a z ratio of 0.9/1.1 = 0.818, has a <u>higher</u> catalytic activity than where the z ratio is 1.0. *See* Takagaki *et al.* at Section 3. Not only are the z values of Takagaki *et al.* outside the claimed range, but one of ordinary skill would understand this to mean that a lower Ti/Nb ratio of 0.818 is better than a ratio of 1.0. *See* Response of 05/03/2009 at p. 5. In other words, this directional shift in the z ratio to 0.818 teaches <u>away</u> from the claimed invention, which recites a z ratio of 1.2<z<1.4.[1] That the claimed z ratio would provide a better activity is completely unexpected.

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[1] Inventors Michikazu Hara and Kazunori Domen are co-authors of Takagaki *et al.*

Takagaki *et al.* also fails to teach the presently claimed limitations for $x$ and $y$. The reference discloses single data points not included in the claimed ranges. Even if one were to include the ranges between these points, the values for $y$ do not overlap. *See* Table A, *supra.* Just as there is no motivation to modify the $z$ value of Takagaki *et al.* to reach the claimed range, there is no motivation to modify $x$ and $y$, because $z = x / y$. A lower value for $z$ is preferred by the reference than what is claimed. *See* Takagaki *et al.* at Section 3. Accordingly, Takagaki *et al.* would not provide motivation to decrease the value of $y$ relative to $x$, but rather to increase it, which moves one farther away from the claimed values.

The miscalculated $z$ range of 0.833 to 5 relied upon by the examiner, does not relate to the referenced compounds (Office Action at p. 3, ¶ 1). Even the different compounds disclosed in Takagaki *et al.*: $K_{1-x}Ti_{1-x}Nb_{1+x}O_{14}$ (Ti/Nb=1), $Cs_{1-x}Ti_{2-x}Nb_{1+x}O_7$ (Ti/Nb=2), or $K_{3-x}Ti_{5-x}Nb_{1+x}O_{14}$ (Ti/Nb=5) fail to support the range (Section 2). Moreover, these compounds form only the salts of cesium or potassium, whereas the claimed compound is $HTi_xNb_yO_5$. Takagaki *et al.* does not evaluate the cesium and potassium salts as a solid acid catalyst. *Id.* Rather, they are the lamellar metal oxides. *Id.* Therefore, the Ti/Nb ratio values for these compounds cannot be relied upon to assert an expanded range of 0.833 to 5 that meets the claim for a solid acid catalyst. *See* Response of 05/03/2009 at p. 5; *see*

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*also* Response of 11/20/2008 at p. 6). The examiner's assertion that the "activities of the solid acid catalysts are disclosed based on the ratio of titanium to niobium and catalyst function is not drawn to the hydrogen, cesium, or potassium components" is irrelevant (Office Action at p. 7, ¶ 2). The lamellar metal oxide is used in the claimed process steps for synthesizing the solid acid catalyst contains titanium, niobium and an alkali metal. *See* specification at p. 2, ¶ 2. The claimed Ti/Nb ratio, however, is that for the claimed <u>catalyst</u> and not for the lamellar metal oxide. *See Id.*; *see also* specification at p. 4, ¶ 3. The Ti/Nb ratio for the lamellar metal oxide used in the Takagaki *et al.* experiment does not apply to the resulting ratio for the end product: the catalyst. The relevant compounds, and thus the relevant Ti/Nb ratios, in Takagaki *et al.* are the hydrogen compounds described above. Claims 1 and 3 are each separately argued on these grounds.

### B. Product-By-Process Claim Construction Requires Consideration of Process Steps

In order to establish a *prima facie* case of obviousness, the cited prior art reference must teach or suggest all claim limitations. In light of the recent decision of the U.S. Court of Appeals for the Federal Circuit in *Abbott Laboratories v. Sandoz, Inc.*, Applicants submit a new argument that the rejection of Claims 1 and 3 is based upon improper claim construction for product-by-process claims. 2009 WL 1371410 (Fed. Cir. 2009).

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Each of Claims 1 and 3 is directed to a solid acid catalyst represented by $HTi_2Nb_yO_5$, where $x$ is $1.1<x<1.2$, $y$ is $0.9>y>0.8$, and the Ti/Nb atomic ratio $z$ is $1.2<z<1.4$, obtainable by a recited process. The examiner stated that the process limitations in such a claim are given little weight. However, for product-by-process claims, "each element contained in a patent claim is deemed material to defining the scope of the patented invention." *Abbott Labs. v. Sandoz, Inc.*, 2009 WL 1371410 at *9 (Fed. Cir. 2009) (quoting *Warner-Jenkinson Co., Inc. v. Hilton Davis Chemical Co.*, 520 U.S. 17, 19 (1997)). Despite controlling precedent, the examiner concluded, without any explanation, that the "claimed product appears to be the same or similar to that of the prior art." (Office Action at p. 3, ¶ 2). The examiner suggested that this alone satisfied a *prima facie* case of obviousness even though it was acknowledged that the claimed product is *"produced by a different process." Id.* (emphasis added).

Decisions of the Board typically rely on *In re Thorpe* to reject product-by-process claims on the grounds of obviousness or anticipation, relying on the clause in the holding that "determination of patentability is based on the product itself." 777 F.2d 695, 697 (Fed. Cir. 1985). Although *Abbott Labs.* cites *Thorpe* with approval, the rule of *Abbott Labs.* is that "process terms in product-by-process claims serve as limitations in determining infringement," and this rule "applies to

claim construction overall." 2009 WL 1371410 at *9. In fact, it is the first clause

of the *Thorpe* holding that receives the full support of the Federal Circuit: "product

by process claims are limited by and defined by the process." *Id.* (quoting *Thorpe*,

777 F.2d at 697).

As a general matter, the claims cannot be construed differently for the

purposes of validity and infringement. *See, e.g., Amgen Inc. v. Hoechst Marion*

*Roussel, Inc.*, 314 F.3d 1310, 1330 (Fed. Cir. 2003) ("It is axiomatic that claims

are construed the same way for both validity and infringement."). To the extent

that the Patent Office and the Board have treated product-by-process claims as

product claims where process elements are afforded little consideration, they have

not acted in accordance with the rule of the Federal Circuit. *Thorpe* is also not in

conflict with this principle. The product at issue there was not new. *See Abbott*

*Labs.*, 2009 WL 1371410 at *24 (Newman, J. dissenting).

Regarding the present invention, there is no evidence in the record that the

composition in Takagaki *et al.* is the same as the claimed product. The examiner

stated that they appeared to be "the same or similar." (Office Action at p. 3, ¶ 2).

According to the above rule of claim construction for product-by-process claims,

the process steps distinguish the claimed invention from products made by other

processes. Even if the compositions are the same, which Applicants do not

concede, instant Claim 1 is properly limited to and defined by the recited process steps which are not taught by Takagaki *et al.* Accordingly, a *prima facie* case of obviousness has not been established.

## II. Claim 10 is improperly rejected under 35 U.S.C. 103(a) as being unpatentable over Takagaki *et al.*

Claim 10 is drawn to an ester dehydration condensation catalyst comprising the claimed catalyst, wherein the organic amine or organic ammonium is at least one selected from the group of ethylamine, propylamine, or tetrabutylammonium. To the extent that Claim 10 includes the limitations of Claim 1, the above arguments over Takagaki *et al.* apply.

Takagaki *et al.* teaches higher activity in liquid phase esterification using the composition $H_{0.9}Ti_{0.9}Nb_{1.1}O_5$ compared to $HTiNbO_5$ (Section 3). Although Takagaki *et al.* provides a motivation to change the composition, the motivation would be to make the z ratio 0.818 or lower. Takagaki *et al.* teaches that the composition $H_{0.9}Ti_{0.9}Nb_{1.1}O_5$, which has a $z$ ratio of $0.9/1.1 = 0.818$, has a higher catalytic activity than where the $z$ ratio is 1.0. *See* Takagaki *et al.* at Section 3. Not only are the $z$ values of Takagaki *et al.* outside the claimed range, but one of ordinary skill would understand the reference to mean that a lower Ti/Nb ratio of 0.818 is better than a ratio of 1.0, such that one would be motivated to experiment with ranges below 1.0, which is farther away from the claimed range of 1.2 to 1.4.

*See* Response of 05/03/2009 at p. 5. In other words, this directional shift in the z

ratio to 0.818 teaches <u>away</u> from the claimed invention, which recites a z ratio of

1.2<z<1.4, and is an unexpected result.

Takagaki *et al.* clearly suggests that different compositions of $HTiNbO_5$

having a Ti/Nb ratio below the claimed ranges than that of $HTiNbO_5$ (z=1) would

produce higher activity. Therefore, one of ordinary skill would not have been

motivated to produce a highly active ester dehydration condensation catalyst by

modifying Takagaki *et al.* to cover the claimed ranges.

**III.    Claim 5 is improperly rejected under 35 U.S.C. 103(a) as being unpatentable over Takagaki *et al.* in view of Hara *et al.***

Claim 5 is drawn to the solid acid catalyst of Claim 1 and adds a further

limitation that the coagulated titanium niobate nano-sheet is ten times or more the

surface area of the cation changeable lamellar metal oxide proton exchanger and is

in the range from $60m^2/g$ to $150m^2/g$. Insofar as Claim 5 depends on or contains

the limitations of Claim 1, the foregoing arguments over Takagaki *et al.* apply.

Applicants submit new arguments over Hara *et al.*, because previous responses to

rejections focused on the applicability of Takagaki *et al.* and Yoshida *et al.*, the

latter of which as since been withdrawn.

The solid acid catalyst taught in Hara *et al.* is $HTiNbO_5$. The limitations *x*,

*y*, and *z* are outside the claimed range (x=1, y=1, z=1). The specification of the

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present invention shows that as these values change, the surface area of the coagulation sheet changes (p. 6, ¶ 2; p. 7, ¶2; p. 8, ¶ 3).

Even if one would be motivated to use the values from Takagaki *et al.*, there is no indication that the resulting surface area would be within the claimed range. Hara *et al.* instead suggests that using "similar" (Office Action at p. 6) processes could yield different results for surface area. Hara *et al.* teaches a surface area of $150m^2/g$ for the nano-sheet after removal where the lamellar metal oxide is $KTiNbO_5$ and the solid acid catalyst is $HTiNbO_5$ (Section 2). Comparative Example 1 of the present invention examines the same compounds, although the Ti/Nb value falls outside the claimed range. *See* specification at p. 8. The resulting surface area of the $HTiNbO_5$ coagulation sheet in this example is $143m^2/g$. *Id.* Using the same values for *x*, *y*, and *z* yields different results between the Hara *et al.* process and the process of the present invention. This demonstrates a level of unpredictability such that there would be no motivation for one skilled in the art to combine Hara *et al.* with Takagaki *et al.* Hara *et al.* cannot be used to provide predictable surface area values for the coagulation sheet where the Ti/Nb value changes or where the process of production differs. Hara *et al.* simply discloses varied surface areas for other known catalysts for purposes of comparison to the

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HTiNbO$_5$ aggregate (Section 3). It is not at all clear that experimentation outside of the claimed Ti/Nb ratio range would provide predictable surface area results.

Further, a new argument is submitted that the examiner incorrectly applied the test for product-by-process claims because "each element contained in a patent claim is deemed material to defining the scope of the patented invention." *Abbott Labs. v. Sandoz, Inc.*, 2009 WL 1371410 at *9 (Fed. Cir. 2009) (quoting *Warner-Jenkinson Co., Inc. v. Hilton Davis Chemical Co.*, 520 U.S. 17, 19 (1997)). Hence, the assertion that process limitations in a process claim are given little weight cannot reject Claim 10.

## IV. Claim 12 is improperly rejected under 35 U.S.C. 103(a) as being unpatentable over Takagaki *et al.* in view of Hara *et al.*

Claim 12 is drawn to an ester dehydration condensation catalyst comprising the solid acid catalyst of Claim 5. The examiner alleged that Claim 12 merely recites an intended use of the invention (Office Action at p. 6, § 2). This is incorrect because no such allegation was made regarding the ester dehydration condensation catalyst of Claim 10. The examiner required a showing of structural differences between the claimed invention and the prior art, because a prior art structure meets the claim if it is capable of performing the same intended use. *Id.* This rejection is improper. The structures of the compounds are clearly different, because Takagaki *et al.* does not disclose the claimed *x*, *y*, and *z* proportions. This

fact is conceded by the examiner in the rejection of Claim 1 (Office Action at p. 3, ¶ 3).

To the extent that the examiner also rejected Claim 12 on the same or similar grounds as Claims 1, 5, and 10, the foregoing arguments over Takagaki *et al.* and Hara *et al.* apply. Notably, there would be no motivation to modify the structure of the Takagaki *et al.* compounds to reach the claimed compound. There is also no indication that the catalyst would have the same resulting surface area, because the teaching of Hara *et al.* cannot be combined with Takagaki *et al.* to provide predictable results for surface area.

Claim 12 is also not obvious over Takagaki *et al.* for the same reasons that the ester dehydration catalyst of Claim 10 is not. In addition, Hara *et al.* teaches that $HTiNbO_5$ produced by different processes may not be as active as a solid acid for liquid phase esterification (Section 3). The present invention teaches that the catalyst of Hara *et al.* is not preferred for purposes of liquid phase esterification, because there is higher activity where the compound is limited to the claimed Ti/Nb ratio. *See* Fig. 3. Modifying the compound of Hara *et al.* according to the ranges of Takagaki *et al.* would produce even less optimal results for activity in liquid phase esterification reaction, because Takagaki *et al.* teaches away from the present invention for the reasons previously stated.

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The fact that the claimed compounds and the prior art compounds might all be used in liquid phase esterification, at various levels of effectiveness relative to other known catalysts, is irrelevant. The claimed catalyst is different from nor is it obvious over Takagaki *et al.* or Hara *et al.*, because the prior art references do not reach every limitation of the instant claims.

Also, since there is no evidence in the record that the composition in Takagaki *et al.* is the same as the claimed product, a new argument is submitted that the *Abbott Labs* rule to distinguish the claimed invention from products made by other processes has not been properly applied. Even if the compositions are the same, which Applicants do not concede, Claim 12 is properly limited to and defined by the recited process steps which are not taught by Takagaki *et al.* Accordingly, a *prima facie* case of obviousness has not been established.

## V.     Conclusion

For all the foregoing reasons, Applicants submit that all pending claims in the application are allowable over the art of record, and early notice to that effect is respectfully requested.

Respectfully submitted,
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## APPENDIX

## CLAIMS

1. (Rejected) A solid acid catalyst represented by $HTi_xNb_yO_5$, wherein x is 1.1<x<1.2 and y is 0.9>y>0.8, having a Ti/Nb atomic ratio z of 1.2<z<1.4, obtained by proton changing of alkali metal cation of cation changeable lamellar metal oxide in which polyanion nano-sheet comprising lamellar metal oxide layers of titanium niobate lying alkali metal cation between are regularly laminated by inorganic acid or organic acid adjusted to 0.0001M to 1M, delaminating said laminated layers temporarily by inserting cation selected from the group consisting of organic amine or organic ammonium between layers of proton exchangers, preparing an aqueous colloidal solution comprising metal oxide sheets to which said organic amine or organic ammonium is absorbed, then proton exchanging said organic amine or organic ammonium by adding inorganic acid or organic acid adjusted to 0.0001M to 1M to said aqueous colloidal solution and simultaneously coagulating on titanium niobate nano-sheet.

2. (Canceled)

3. (Rejected) The solid acid catalyst of claim 1, wherein organic amine or organic ammonium is at least one selected from the group consisting of ethylamine, propylamine or tetrabutylammonium.

4. (Canceled)

5.    (Rejected)  The solid acid catalyst of claim 1, wherein the surface area of coagulated titanium niobate nano-sheet is 10 times or more to the surface area of cation changeable lamellar metal oxide proton exchanger and is in the range from 60 $m^2g^{-1}$ to 150 $m^2g^{-1}$.

6.    (Canceled)

7.    (Canceled)

8.    (Canceled)

9.    (Canceled)

10.    (Rejected)  An ester dehydration condensation catalyst comprising the solid acid catalyst of claim 3.

11.    (Canceled)

12.    (Rejected)  An ester dehydration condensation catalyst comprising the solid acid catalyst of claim 5.

13.    (Canceled)

14.    (Canceled)

# CLAIM SUPPORT AND DRAWING ANALYSIS

1. (Rejected) A solid acid catalyst represented by $HTi_xNb_yO_5$, wherein x is 1.1<x<1.2 {**specification page 2, line 35**} and y is 0.9>y>0.8 {**specification page 2, line 35**}, having a Ti/Nb atomic ratio z of 1.2<z<1.4 {**specification page 3, line 14**}, obtained by proton changing of alkali metal cation of cation changeable lamellar metal oxide {**specification page 3, lines 1-2**} in which polyanion nano-sheet comprising lamellar metal oxide layers of titanium niobate lying alkali metal cation between are regularly laminated by inorganic acid or organic acid adjusted to 0.0001M to 1M {**specification page 3, lines 2-5**}, delaminating said laminated layers temporarily by inserting cation selected from the group consisting of organic amine or organic ammonium between layers of proton exchangers {**specification page 3, lines 5-7**}, preparing an aqueous colloidal solution comprising metal oxide sheets to which said organic amine or organic ammonium is absorbed {**specification page 3, lines 7-9**}, then proton exchanging said organic amine or organic ammonium by adding inorganic acid or organic acid adjusted to 0.0001M to 1M to said aqueous colloidal solution {**specification page 3, lines 9-13; Fig. 1**} and simultaneously coagulating on titanium niobate nano-sheet {**specification page 3, line 13; Fig. 4**}.

2. (Canceled)

3.   (Rejected)  The solid acid catalyst of claim 1, wherein organic amine or organic ammonium is at least one selected from the group consisting of ethylamine, propylamine or tetrabutylammonium {**specification page 3, lines 15-17**}.

4.   (Canceled)

5.   (Rejected)  The solid acid catalyst of claim 1, wherein the surface area of coagulated titanium niobate nano-sheet is 10 times or more to the surface area of cation changeable lamellar metal oxide proton exchanger and is in the range from 60 $m^2g^{-1}$ to 150 $m^2g^{-1}$ {**specification page 3, lines 18-22**}.

6.   (Canceled)

7.   (Canceled)

8.   (Canceled)

9.   (Canceled)

10.   (Rejected)  An ester dehydration condensation catalyst comprising the solid acid catalyst of claim 3 {**specification page 3, lines 23-24**}.

11.   (Canceled)

12.   (Rejected)  An ester dehydration condensation catalyst comprising the solid acid catalyst of claim 5 {**specification page 3, lines 23-24**}.

13.   (Canceled)

14.    (Canceled)

## MEANS OR STEP PLUS FUNCTION ANALYSIS

None.


## EVIDENCE

None


## RELATED CASES

None